The product that we have developed utilizes the Emotiv Electrode system to control an arm brace using EEG/Facial EMG signals. This product is marketed towards quadriplegic and stroke patients who no longer are able to move their arms. It is intended to be used as a therapeutic system to help these patients regain arm control. The system has two mode, EMG and EEG. In EMG mode, the user blinks the left eye to move the arm down and right eye to move the arm up. In EEG mode, the user simply thinks up to move up, and thinks down to move down. The built in Gyro in the Emotiv allows the arm brace to stop, in both modes, with a tilt of the head. Through training and practice the patient will learn to send these commands to the motor built into the brace which will in turn lead to stronger neuroplasticity and the ability for the user to move their arm without the need of the device. This stronger neuroplasticity will come through the mass practice, of using the device, and successful reinforcement through visual and neural commands.

How The System Works

- The Emotiv is placed on the head in the proper position (Electrodes are in line with the motor cortex)
- The user chooses which mode to be in (EEG or EMG)
- User sends the proper commands depending on the current mode
- The Emotiv picks up these signals off the brain or facial muscles, depending on the mode
- Emotiv sends this data wirelessly on a Bluetooth band to an acquisition computer
- The data is sent through Matlab and analyzed for proper triggering signals.
- Once a triggering signal is identified by Matlab, a signal is sent to the motor through a serial port connection.
- The motor then drives the lower arm of the brace which is connected to the subjects arm.
- The user can now move their physical arm through these two modes to any angle of their choosing.
- Long practice will now insure stronger neuroplasticity which will allow the user to move their arm under their own control, without the need of system.

Many tests were done to insure this system is safe and reliable.

Safety

The system has three main safety features:
1. Physical- The brace has physical solid points at the outside range of the brace, from 0 to 105°, where the lower arm of the brace will hit if it tried to exceed this boundary. This safety measure insures the subjects arm will not be bent the wrong way or past the natural range of motion.
2. Software- There are many lines of code in Matlab that will prevent the brace from ever even reaching these virtual boundaries on the brace and thus prevent the motor from ever going to these set limits.
3. Motor Stall Limit- The motor has a set defined torque load. If the user resists the motor past this torque limit, the system will automatically shutoff and reinitializing will be needed to get the system up and running again.

Reliability

- EMG mode is 100% reliable.
- EEG mode is very dependent on the user but is usually over 95% reliable with initial training and practice from the user.
- The brace was put under many stress and strain tests and proved to be very reliable.

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References